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MALE BEES SPORT BLACK MUSTACHES FOR PICKING UP PARSNIP PERFUME (HYMENOPTERA: ANTHOPHORIDAE)

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Abstract.—Groups of males of the nearctic *Anthophora abrupta* Say (Apoidea: Anthophorini) chew parsnip tissue, collect the odorous juice in unique adsorptive labral mustaches of fine, flattened hairs, and apply it to surrounding objects, apparently mixed with their mandibular gland secretion. Such perfumed areas outline an oval flight path. This resembles the fragrance-collecting and territorial behavior of male neotropical orchid bees (Apidae: Euglossinae).

The neotropical orchid bees (Apidae: Euglossinae) are well known for the unusual behavior of the males that collect fragrances from flowers and elsewhere. Using special pads of adsorptive hairs on their front feet, they brush the surface, then pack the collected fragrance into special hair-lined cavities in their hind tibiae. These perfumes are evidently used to maintain territories (Dodson, 1973; Dressler, 1982). The fragrances may also be sequestered for use in producing male mandibular gland attractant pheromones (Williams and Whitten, 1983). Similar behavior, not previously known among any other bees, is here reported to occur in the nearctic species, *Anthophora abrupta* Say (Anthophoridae: Anthophorinae).

A large solitary bee, *A. abrupta* nests in dense aggregations in vertical clay banks or adobe walls (Frison, 1923; Rau, 1929; Norden et al., 1980; Norden, 1984). Little is known of the sexual behavior of this species. Mating was not seen at the nesting site, although occasional males followed and pounced on females returning from the field. Caged insects mated on flowers (Norden, 1984).

For several years, Jean Worthley (pers. comm.) noticed *A. abrupta* visiting a patch of naturalized parsnips at her farm in Owings Mills, Baltimore County, Maryland. On the sunny mornings of June 15 and 17, 1982, and June 11, 14, and 21, 1984, we visited the site, where we observed and filmed the unique male behavior described here. Both years, male *A. abrupta* were clustering on a parsnip plant (*Pastinaca sativa* L.) growing in partial shade under a loblolly pine about 75 m from the nest site and 18 m from a small pool where females were ingesting water. Neighboring plants that had been previously defoliated by the bees bore many brown, necrotic lesions on their stems. Neither male nor female bees were visiting the flowers of these parsnips; nor were any bees of either sex seen on several cultivated parsnips growing in a sunny garden 50 m away. In 1983, males also visited parsnips at the shady site, but not those in the garden (J. Worthley, pers. comm.). Males, individually marked while on the parsnip, were observed to return to the plant after 1–1.5 hours.

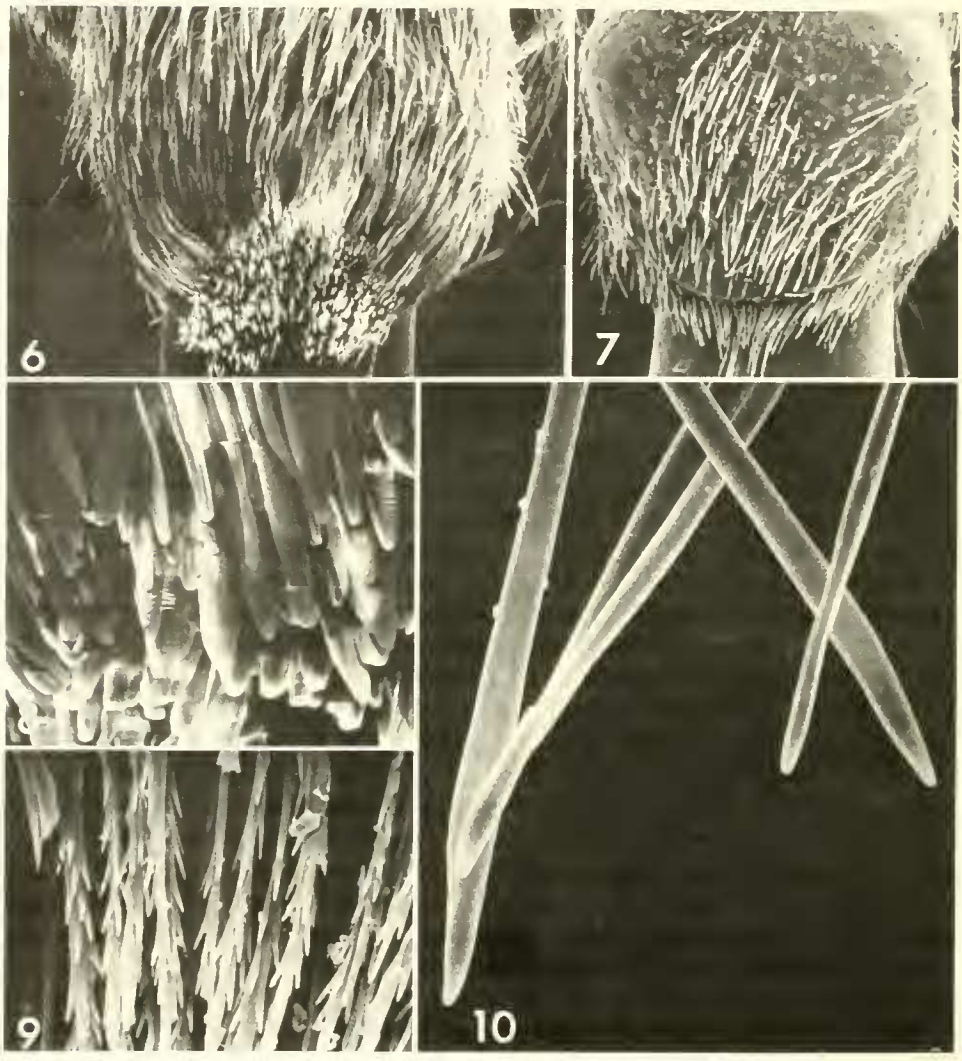
Fig. 1. Cluster of four male *A. abrupta* chewing on parsnip leaves and petioles. Note portions of leaves that have been shredded by the bees.

The male bees alternately chewed the parsnip tissue for 11–86 s and periodically raised their heads for 2–7 s. Chewing bouts were often terminated when incoming bees butted or alighted nearby. Previously chewed areas were preferentially visited. When a much-chewed parsnip was removed and replaced with a fresh plant, bees visiting the area did not chew on the new plant, but instead located broken, chewed sprigs of the old plant lying on the ground. As many as 65 males at a time were seen simultaneously chewing on the parsnip's leaves, petioles, or stem (Fig. 1). During the chewing phase, the bee's antennae were directed toward the substrate (Fig. 2); these normally alert, active bees lost their wariness and could be touched by hand. This resembles the oblivious behavior of certain fragrance-collecting

Figs. 2–5. Behavior of *A. abrupta*. 2, Male with deflected antennae, intently chewing on a parsnip petiole. 3, Male on bee-damaged leaf, with his head raised and proboscis partly unfolded as he champs his mandibles while packing parsnip juice into his labral mustache. 4, Male (arrow) applying parsnip odor to grass stem. 5, Female attracted to a netful of females.

male orchid bees (Dressler, 1982). Males marking objects were much more alert than those that were chewing on parsnip, and could not be touched or approached within about 30 cm. During the brief head-lifting phase (Fig. 3), the mandibles were rapidly vibrated or champed and the proboscis was partly unfolded, apparently to help drive the plant's juices in among the mustache hairs.

Males also chewed on the broken ends of dry, dead stems (Fig. 4) in a clump of *Panicum* growing in partial shade about 4 m from the parsnip. Another cluster of males was found among grasses in full sun about 30 m from the parsnip. The *Panicum* stems that had been chewed smelled distinctly of parsnip odor; unchewed stems had no such odor. When a chewed stem was moved 15 cm away, several males located and chewed on it. Males also marked two auto bumpers, an *Amaryllis* plant, and a honeysuckle bush. They followed the bumpers and *Amaryllis*



Figs. 6–10. Labrum and labral hairs of *Anthophora* spp. 6, Labrum of male *A. abrupta* bearing dense mustache (×40). 7, Mustacheless labrum of male *A. occidentalis* as typical of other Anthophorini (×40). 8, Densely packed hairs of *A. abrupta* mustache (×550). 9, Branched, nonspecialized labral hairs of male *A. occidentalis* (×550). 10, Isolated mustache hairs of *A. abrupta* (×750). These smooth hairs have flattened tips that may enhance adsorption by capillarity.

when they were moved 1–3 m. The group of parsnips, bumpers, *Amaryllis*, honeysuckle, and grass locations formed an oval area measuring approximately 190 m × 25 m. This oval area was upwind (prevailing) of most female activity. All marked objects were within 1 m of the ground. No females were attracted to the males on the parsnip or to those marking elsewhere; however, females (but not males) were attracted to other females confined in a net near the parsnips (Fig. 5), and two females were attracted to a group of netted males taken to the pool.

Dissection of several males revealed that their mandibular glands produced a distinct, sweet fragrance. A similar-smelling, geraniol-like mandibular gland se-

Fig. 11. Male *A. abrupta* marking the rubber bumper of an automobile. The dark patches (arrows) are droplets observed to be deposited when males abrade the surface with their mandibles and then rub the area with their saturated mustaches.

cretion of *Anthophora occidentalis* Cresson attracts other males (Batra, 1978). Male *A. abrupta* are unique in possessing a labral mustache of fine black hairs (Figs. 6–10 and Brooks, 1983). This mustache smelled strongly of parsnip odor in specimens that were collected as they chewed on the parsnip, bumpers, or grass. Some tattered and presumably old males bore mustaches that had a central bald area where hairs had evidently worn off during chewing and marking. The specialized mustache hairs are densely packed and apically flattened, apparently to increase capillary adsorption of the parsnip juice. Certain oil-collecting bees also have flattened or otherwise specialized hairs (Vogel, 1971, 1981; Simpson et al., 1977; Roberts and Vallespir, 1978; Neff and Simpson, 1981; and Dressler, 1982).

An examination of males and females of 81 species of Anthophorini (76 *Anthophora*, two *Habropoda*, two *Clisodon*, and one *Microanthophora*) in the collection of the U.S. National Museum of Natural History revealed no other mustache-bearing species. Males of 52 species, however, bore sometimes elaborate brushes on their mid- and hindtibiae or tarsi that may serve a similar perfume gathering and distributing function. Thus, it appears that *A. abrupta* males are unique among Anthophoridae and second only to the Euglossinae in their use of plant fragrances in probable combination with mandibular gland pheromones to demarcate territories (Fig. 11).

Because parsnip is a recent immigrant of Eurasian origin, the preference of male *A. abrupta* for this plant is puzzling. Perhaps these native bees originally used a native species of Umbelliferae. However, they did not visit *Daucus* or *Cryptotaenia* growing in the garden. Specialized phytophagous insects apparently use the toxic furanocoumarins of Umbelliferae as host-recognition cues (Berenbaum,

1981a). It is interesting that *A. abrupta* prefers parsnips growing in shade, which produce fewer furanocoumarins than those growing in the sun (Berenbaum, 1981b). Rau (1929) observed groups of male *A. abrupta* persistently chewing on rusty slag at a barren patch of ground about 100 m from a nest site. These males quite possibly were marking a territory similar to the one we have observed.

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